

Evaluation of the Effect of COVID-19 Pneumonia on Kidney Function

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Abstract

Background: Severe acute respiratory tract infection, pneumonia, kidney failure, and multi-organ failure may develop in cases that result in death due to COVID-19. It is emphasized that the awareness of healthcare professionals about kidney functions should be increased in cases of COVID-19 pneumonia. Quick and effective steps can be taken in the treatment of COVID-19 pneumonia with the controlling approach of nurses to changes in kidney functions.

Method: This study was carried out retrospectively to evaluate the kidney functions of patients diagnosed with COVID-19 pneumonia who were hospitalized in the pandemic hospital. Hospital and nurse observation files of 120 patients who were introduced to COVID-19 pneumonia between 1 May and 30 November 2020 were examined. Categorical data were described as continuous data as median with interquartile range (IQR) and percentages (%).

Results: In total, 30 patients (25.0%) required mechanical ventilation, Overall, 39.1% (47) developed acute kidney injury during hospitalization, out of which 10.8% reached stage 1, 15.0% reached stage 2, and 13.3% reached stage 3. Dialytic support was required for seven (17.1% of all patients). COVID-19 pneumonia patients had higher levels of aspartate aminotransferase (AST) (55.02 ± 58.04), alanine aminotransferase (ALT) (74.07 ± 140.94), lactate dehydrogenase (LDH) (483.48 ± 477.51), C-reactive protein (CRP) (88.02 ± 72.17), D-dimer (1023 ± 1548.01), procalcitonin (3.70 ± 6.52). In addition, a proportion of COVID-19 pneumonia patients but no non-COVID-19 pneumonia patients had abnormally increased AST (10.0-274.0), ALT (7.0-854.0), LDH (164-3547), CRP (5.10- 310.90), D-dimer (151-6212), procalcitonin (195-433). SpO₂ of COVID-19 pneumonia patients had 78-97%, patients who need dialysis treatment due to pneumonia, follow-up coagulation profile (Procalcitonin, LDH, D-dimer), liver-renal function (ALT, AST, Creatine, Urea, Albumin), assessing signs of DVT and psychological support. 89 patients (74.2%) received corticosteroid, 73 patients (60.8%) received expectorant, 61 patients (50.8%) received vitamin C or B complex, 110 patients (91.7%) received anticoagulant and 73 patients (60.8%) received antibiotics. All of the COVID-19 pneumonia patients received the antiviral drug.

Conclusion: As the disease progresses, differences in laboratory results and radiological findings may indicate that some complications have developed. COVID-19 pneumonia draws attention with liver function tests such as AST / ALT, LDH, infection markers in the blood, and the high rate of coagulation factors such as PCT and D-dimer during the hospital stay. The fact that these elevated values may cause necrosis in the kidneys also brings about the truth. Careful monitoring of laboratory findings such as elevation of AST / ALT, LDH, PCT, and D-dimer in patients who develop pneumonia due to COVID-19 may provide early action for kidney damage.

Keywords: COVID-19 pneumonia, kidney damage, nursing care

1. Introduction

After the notification of pneumonia cases of unknown etiology in Wuhan, China, a new type of CoV (SARS-CoV-2) was determined as an agent in January 2020, and the causative virus was identified as COVID-19 [1]. COVID-19 has spread worldwide, affecting almost all countries, and has been recognized as a pandemic by the World Health Organization (WHO) [3,4]. Severe acute respiratory tract infection, pneumonia, renal failure,

and multi-organ failure may develop in cases that result in death due to COVID-19 [2-4].

Kidney function impairment develops quite frequently in patients infected with COVID-19. It has been reported that approximately 92% of patients who developed impaired kidney function after being infected with COVID-19 died [1,5]. In studies conducted in China and the United

States, it has been found that the rates of kidney damage in patients infected with COVID-19 are at very alarming levels [5, 6].

Therefore, kidney damage is defined as one of the complications that can develop especially in individuals infected with COVID-19. Similarly, the addition of kidney failure in patients with COVID-19 pneumonia constitutes one of the severe pictures of the disease [6]. In the study conducted by Cheng et al. (2020), it was found that the prevalence of kidney disease at hospitalization and development of kidney damage during hospital stay was high in patients infected with COVID-19, and it was found to be associated with in-hospital mortality [7]. Monitoring renal function in patients treated with COVID-19 pneumonia may contain important information about the course of the disease. It is emphasized that the awareness of healthcare professionals about kidney functions should be increased in cases of COVID-19 pneumonia [8]. Quick and effective steps can be taken in the treatment of COVID-19 pneumonia with the controlling approach of nurses to changes in kidney functions. Nurses need guidelines for this new disease and its developing complications.

In this study, the reflection of the evaluation of kidney functions in patients with COVID-19 pneumonia on nursing care has been discussed and it is thought that the patient who develops COVID-19 pneumonia will make significant contributions to nursing care.

2. Methods

2.1 Study design and participants

This study was carried out retrospectively to evaluate the kidney functions of patients diagnosed with COVID-19 pneumonia who were hospitalized in the pandemic hospital. Hospital and nurse observation files of 120 patients who were introduced to COVID-19 pneumonia between 1 May and 30 November 2020 were examined. Research approval (2020-05 / 28) was granted by the ethics board of Sivas Cumhuriyet University Faculty of Medicine / Turkey.

2.2 Research Inclusion and Exclusion Criteria

(1) being over 18 years (2) confirmed COVID-19 based on a positive RNA test (3) presence of ground-glass opacity in computed tomography (CT); considered compatible with COVID-19 pneumonia [9,10] Pregnant women and patient records for which sufficient patient information was not available were not included in the study.

2.3 Data Collection

Nursing records, laboratory findings, and chest X-ray records were reviewed by the researcher for all COVID-19 pneumonia patients from May to November 2020. Clinical, radiological, and laboratory data were accessed from hospital records. Clinical data, age, gender, clinical presentation, presence of comorbidities, creatinine, and urea levels were recorded.

The researcher did not contact patients or family. The study protocol and written informed consent were approved by the ethics committee. Research approval (2020-05 / 28) was granted by the ethics board of Sivas Cumhuriyet University Faculty of Medicine / Turkey. No personal information from patients was collected to protect patient privacy and ensure confidentiality.

2.4 Statistical Analysis

Categorical data were described as continuous data as median with interquartile range (IQR) and percentages (%). All statistical analyses were performed using SPSS Statistics version 22.0 software.

3. Results

Characteristics of COVID-19 Pneumonia Patients

Characteristics of cases are shown in Table 1, 120 COVID-19 pneumonia patients had included in this study. The mean age was 64.12 ± 10.77 (42-79) years in COVID-patients. There were 43(35.9%) female COVID-19 pneumonia patients. COVID-19 pneumonia patients have the highest hypertension (60.4%) and diabetes. On admission, the most common symptoms of COVID-19 pneumonia patients were (87.5%) dyspnea, (60.0%) fever, (48.3) sore throat, and (47.5%) cough.

On admission, of the 120 COVID-19 pneumonia patients were 90 (75.0%) had bilateral involvement, 105 (87.5%) multiple lobular ground-glass opacity, and PO₂/FiO₂ ratio mean 256.4 ± 157 . In total, 30 patients (25.0%) required mechanical ventilation, Overall, 39.1% (47) developed AKI during hospitalization, out of which 10.8% reached stage 1, 15.0% reached stage 2, and 13.3% reached stage 3. Dialytic support was required for seven (17.1% of all patients).

Laboratory Test Results of the Patients

Laboratory test results of the patients are shown in Table 2. In this study, white blood cell (WBC) (7.66 ± 4.20) and the ratio of neutrophils (68.05 ± 41.39) counts of investigated COVID-19 pneumonia patients were in the normal range.

COVID-19 pneumonia patients had higher levels of aspartate aminotransferase (AST) (55.02 ± 58.04), alanine aminotransferase (ALT) (74.07 ± 140.94), lactate dehydrogenase (LDH) (483.48 ± 477.51), C-reactive protein (CRP) (88.02 ± 72.17), D-dimer (1023 ± 1548.01), procalcitonin (3.70 ± 6.52). In addition, a proportion of COVID-19 pneumonia patients but no non-COVID-19 pneumonia patients had abnormally increased AST (10.0-274.0), ALT (7.0-854.0), LDH (164-3547), CRP (5.10-310.90), D-dimer (151-6212), procalcitonin (195-433). SpO₂ of COVID-19 pneumonia patients had 78-97%, (Table 2).

Treatment and nursing care for impaired kidney functions in patients with COVID-19 pneumonia

Nursing care and treatments of the patients are shown in Table 3. Nursing practices applied to COVID-19 patients; isolated room, maintain rest-sound sleep, maintain personal hygiene, oral care, monitor vital signs, management fever, maintain SpO₂>90%, maintain acid-base balance, 30-45 degrees head-end elevation, assessing the risk of pressure sores, psychological support, provide fluids and nutritious high protein diet with vitamins and minerals. However different nursing practices applied to COVID-19; pron position, follow-up of patients who need dialysis treatment due to pneumonia, follow-up coagulation profile (Procalcitonin, LDH, D-dimer), liver-renal function (ALT, AST, Creatine, Urea, Albumin), assessing signs of DVT and psychological support. 89 patients (74.2%) received corticosteroid, 73 patients (60.8%) received expectorant, 61 patients (50.8%) received vitamin C or B complex, 110 patients (91.7%) received anticoagulant and 73 patients (60.8%) received antibiotics. All of the COVID-19 pneumonia patients received the antiviral drug (Table 3).

4. Discussion

In this study, the change in kidney functions of individuals with COVID-19 pneumonia and the nursing care applied were discussed. This study was found that male patients had a higher incidence of disease COVID-19 pneumonia than female. The average age of patients with COVID-19 pneumonia was found to be 64.12 ± 10.77 , and these findings are similar to previous studies on COVID-19 [1,2,3]. Also, the majority of patients included in the study were hypertensive diabetic and CVD (Table 1), which was consistent with recent reports [1,3]. Thus, it can be said that COVID-19 pneumonia is more common in elderly male patients with hypertension diabetes CVD.

The clinical data showed that fever, dyspnea, cough, and fatigue were the most common symptoms in patients. With COVID-19 pneumonia and

also as you can see in the picture below, fever and sore throat (Table 1). These symptoms are also common in other influenza and other respiratory viruses [4]. In this study, 77.8% of COVID-19 pneumonia patients had bilateral pneumonia with multiple spotting and ground-glass opacity on CT images (Table 1). The results of the study are similar to our findings [5, 6]. These radiological findings provide evidence why patients with COVID-19 pneumonia breathe better in the supine position than in the supine position in nursing care [7, 8]. Large-scale studies are needed to understand which positions are better for patients with renal impairment. As with many respiratory virus infections, the WBC and neutrophil counts differ in our study [1, 9]. Mechanical ventilation was used in 25.0% of the patients in this study. In some studies, it has been found that mechanical ventilation is used at rates similar to ours [1, 5, 6].

This study results that COVID-19 pneumonia patients, LDH, CRP, and PCT levels increased (Table 2). CRP and LDH were inflammatory predictors in many pulmonary diseases and inflammation [10, 11]. In cases with higher severity of disease and bacterial coinfection, PCT has been found $>0.5 \mu\text{g/L}$ [10, 4]. In a recent study, a higher level of LDH, CRP, and PCT indicates the negativity in the course of the disease [1, 2, 9]. It is also a harbinger of kidney dysfunction [12]. 39.1% of our study population developed acute kidney injury (AKI) at the time of hospitalization, similar to some studies [13, 14] and higher than some study results [12, 15].

In the COVID-19 pandemic, determining the patient whose kidney functions are impaired and who will need dialysis afterward can make important contributions to the successful organization of nursing care from time to time and equipment.

This study data showed that levels of liver function-associated markers (ALT and AST) were higher in COVID-19 pneumonia patients (Table 2). In other studies showed that ALT and AST increased with severe influence [16, 17]. A series of events such as protein degradation and excessive release of methylation factors occur in association with metabolic damage in the aggravating picture of COVID-19. It can cause the breakdown of residual products by the liver and increase liver enzymes [14-17].

This study data showed that level of D-dimer was higher in COVID-19 pneumonia patients (Table 2). Dynamic changes of D-dimer levels during the disease were prognostic of poor outcome in Chinese patients [18]. It is conceivable that the hypercoagulable state, which appears to be a characteristic complication of severe COVID-19, may in some cases promote the transformation of acute tubular necrosis into cortical necrosis and thus renal failure [17].

When the nursing care given to patients with COVID-19 pneumonia and kidney dysfunction was evaluated within the scope of this study; In addition to similar nursing care, it has been determined that different applications are used due to laboratory and radiological findings (Table 3).

In this study, 26.2% of non-COVID-19 pneumonia with kidney dysfunction patients in nursing care plans, all of COVID-19 pneumonia patients' liver function tests (AST, ALT, LDH) and coagulation factors (PCT, D-dimer) were regularly monitored (Table 3). In a large study from China, patients with severe COVID-19 seem to have higher rates of AST/ALT, LDH [19].

Since pathological studies in COVID-19 patients confirmed the presence of the virus in liver tissue, liver damage in COVID-19 patients may be caused by a viral infection of liver cells, because angiotensin-converting enzyme 2 (ACE2) is expressed in both liver cells for the input cell receptor SARS-CoV2 [20]. Preventing liver damage in nursing care can also prevent early kidney damage. Nurses must regularly monitor the AST

/ ALT and LDH values of COVID-19 pneumonia patients, and both kidney and liver functions.

Almost all of the patients (92.5%) with COVID-19 pneumonia in the patient files examined for the study were receiving anticoagulant treatment (Table 3). High coagulation indicators in COVID-19 patients reveal the need for anticoagulant therapy [21]. Also, it was determined in the study that DVT risk assessment was performed in nursing care applied to COVID-19 pneumonia patients (Table 3). Studies have reported large and small venous and arterial blood clots in COVID-19 patients [22, 23]. Nurses should be careful about deep vein thrombosis. Mindful to carefully evaluate COVID-19 pneumonia patients for signs of clotting, such as unilateral swelling or redness [8, 24].

According to the results of this study, all patients antiviral drugs, 74.1% of patients corticosteroids, 92.5% of patients anticoagulant some pharmacologic treatments are applied to COVID-19 pneumonia patients (Table 3). Used antiviral drugs, had anti-inflammatory and immune modulatory effects and are found to be effective in the management of COVID-19 but some antiviral drugs are known to cause AV blocks, cardiomyopathies, and renal damage [25]. Nurses should closely cardiac monitor and regularly checks patients' QT intervals for these adverse effects [24]. Corticosteroid therapy should be employed in adult patients with COVID-19 disease [1, 2]. However, corticosteroid therapy has side effects therefore it is recommended to monitor vital signs and side effects [26-28]. Large-scale studies are required. In the nurse care plans examined in this study (39.1%), sudden renal dysfunction in patients with COVID-19 pneumonia revealed that patients need psychological support. Such sudden situations can create fear and anxiety in terms of patients and their families [16, 29-31]. The importance of nurses to be equipped in terms of psychological support is consistent with the findings of the study. Nurses should care about not only the improvement of physiological symptoms but also their psychological well-being in the care of individuals infected with COVID-19. For this reason, enriching nurse care plans for methods of coping with stress can be a guide.

4.1 Limitations and further research

This study has a few limitations. First, the small sample size, Second, the inability to access the necessary information in some patient files, and third, the study was conducted from a single center.

5. Conclusion

COVID-19 pneumonia is one of the severe pictures of the disease. As the disease progresses, differences in laboratory results and radiological findings may indicate that some complications have developed. COVID-19 pneumonia draws attention with liver function tests such as AST / ALT, LDH, infection markers in the blood and the high rate of coagulation factors such as PCT and D-dimer during the hospital stay. The fact that these elevated values may cause necrosis in the kidneys also brings about the truth. Careful monitoring of laboratory findings such as elevation of AST / ALT, LDH, PCT and D-dimer in patients who develop pneumonia due to COVID-19 may provide early action for kidney damage. In addition, it is a very important issue that liver function and DVT follow-up should be included in nursing care in COVID-19 pneumonia. There is an urgent need to establish a systematic and scientific nursing care for effective control and treatment to prevent kidney damage, which is among the complications of COVID-19 pneumonia.

5.1 Relevance to clinical practice

In this study, it can be said that COVID-19 pneumonia targets the renal system. In COVID-19 pneumonia; It is suggested that the alarming rise of liver function tests such as AST / ALT, LDH, infection markers in the blood, and clotting factors such as PCT and D-dimer can cause kidney damage. Regular follow-up of these values can contribute to the early regulation of kidney functions by providing nurses to have information

about patient prognosis. Also, it is thought that regular follow-up of these findings may contribute to the prevention of complications such as DVT. In the care of COVID-19 pneumonia, it is seen that acute improvement in symptoms comes to the fore by taking advantage of nurses' experience of care for viral diseases. Therefore, studies investigating kidney damage, one of the complications of COVID-19 pneumonia, are needed. Therefore, this study evaluated early markers of kidney damage caused by COVID-19 pneumonia and steps towards nursing care.

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